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JOHN F. KENNEDY SPACE CENTER, NASA
DESIGN OF
HYDROCARBON FUEL GROUND SUPPORT EQUIPMENT
STANDARD FOR

Design Engineering Directorate
Approved:

D.D. Buchanan

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DESIGN OF
HYDROCARBON FUEL GROUND SUPPORT EQUIPMENT
STANDARD FOR

This standard has been approved by the Design Engineering Directorate of the John F. Kennedy Space Center (KSC) and is mandatory for use by KSC and associated contractors.

1. SCOPE.

1.1 Scope. - This standard, to be used in conjunction with GP-863, establishes the basic design requirements for hydrocarbon fuel ground support equipment designed for use at John F. Kennedy Space Center (KSC), NASA, involving the following hydrocarbon fuels (see 6.2):

Hydrocarbon Fuels

JP-4
JP-5
ASTM Type A
ASTM Type B

Rocket Fuels

RP-1
RJ-1

1.2 Classification. - For the purposes of this standard, Ground Support Equipment (GSE) is classified as follows (see 6.2):

Fixed
Mobile
Portable

2. APPLICABLE DOCUMENTS

2.1 The following documents of the latest issue form a part of this standard to the extent specified herein.

SPECIFICATIONS

Federal

QQ-S-741	Steel, Carbon: Structural Shapes, Plates, and Bars
QQ-S-763	Steel Bars, Shapes, and Forgings, Corrosion-Resisting
QQ-S-766	Steel Plates, Sheets and Strip-Corrosion Resisting

QQ-A-200/8	Aluminum Alloy Bar, Rod, Shapes, Tube and Wire, Extruded, 6061 and 6062
QQ-A-250/11	Aluminum Alloy 6061, Plate and Sheet
<u>Military</u>	
MIL-P-5510	Packing, Preformed, Straight Thread Tube Fitting Boss
MIL-C-10387	Coupling, Clamp, Pipe; With Bolts and Synthetic-Rubber Gasket for Grooved-End Pipe and Tube
MIL-P-10388	Pipe Fittings: One or More Ends Grooved
MIL-R-8791	Retainer, Packing, Hydraulic, and Pneumatic, Tetrafluoroethylene Resin
MIL-F-8901	Filter-Separators, Aviation and Motor Fuel, Ground and Ship-Board Use, Performance Requirements and Test Procedures for

John F. Kennedy Space Center, NASA

KSC-C-123	Specification, Cleanliness Levels, Cleaning, Protection and Inspection Procedures for Parts, Field Parts, Assemblies, Subsystems, and Systems for Fluid Use in Support Equipment
KSC-F-124	Specification for Fittings (Pressure Connections), Flared Tube
KSC-SPEC-Z-0002	Welding, Aluminum Alloy Pipe, Tubing and Associated Fittings, Specification for
KSC-SPEC-Z-0003	Welding, Stainless Steel and Invar 36 Pipe, Tubing and Associated Fittings, Specification for
KSC-SPEC-Z-0004	Welding, Structural, Carbon Steel, Stainless Steel, Low Alloy Steel, and Aluminum Alloys, Specification for

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KSC-SPEC-Z-0007	Tubing, Steel, Corrosion Resistant, Types 304 and 316, Seamless, Annealed, Specification for
KSC-SPEC-Z-0008	Fabrication and Installation of Flared Tube Assemblies and Installation of Fittings and Fitting Assemblies, Specification for
KSC-SPEC-Z-0013	Penetrant, Magnetic Particle and Ultrasonic Inspection, Requirements for, Specification for
KSC-SPEC-Z-0010	Welding, T-1 and T-1 Type A and Type B Structural Steels, Specification for
KSC-SPEC-Z-0019	Age Control of Elastomeric Parts, Specification for

STANDARDSMilitary

MIL-STD-129	Marking for Shipment and Storage
MS28778	Packing, Preformed, Straight Thread Tube Fitting Boss
MS33649	Bosses, Fluid Connection-Internal Straight Thread

John F. Kennedy Space Center, NASA

KC 103	Seal Ring
KC 105	Fitting End, Standard Dimensions for Flared Tube
KSC-STD-E-0002	Hazardproofing of Electrically Energized Equipment, Standard for
KSC-STD-E-0012	Bonding and Grounding, Standard for
KSC-STD-E-0015	Marking of Ground Support Equipment, Standard for
KSC-STD-F-0004	Fire Protection Design for Facilities
KSC-STD-F-0001	Protective Coating of Carbon Steel, Standard for

KSC-E-165 Electrical Ground Support Equipment Fabrication.

KSC-STD-Z-0005 Standard for Design of Pneumatic Systems

DESIGN TECHNICAL INSTRUCTIONS

John F. Kennedy Space Center, NASA

DTI-M-14 Design Technical Instruction for Corrosion Protection of Stainless Steel Tubing Assemblies

DTI-M-23 Design Technical Instruction for Hazardproofing and Environmental Protection of Equipment by Purging

PUBLICATIONS

National Aeronautics and Space Administration, NASA

NHB 5300.4 (1B) Quality Program Provisions for Aeronautical and Space System Contractors

NHB 5300.4 (1C) Inspection System Provisions for Aeronautical and Space System Materials, Parts, Components, and Services

John F. Kennedy Space Center, NASA

KSC-GP-863 General Criteria for Design of New Equipment and Facilities to be Utilized at KSC

TM-584 Corrosion Control and Treatment Manual

KSC-GP-425 Engineering Standards

KSC-GP-469 Explosives Safety Handbook

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

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2.2 The following documents of the latest issue form a part of this standard to the extent specified herein.

American National Standards Institute (ANSI)

B1.1	Unified Screw Threads-Metric Translation
B16.5	Steel Pipe Flanges and Flanged Fittings
B16.9	Factory-Made Wrought Steel Buttwelding Fittings
B16.21	Nonmetallic Gaskets for Pipe Flanges
B18.2.1	Bolts
B18.2.2	Nuts
B31.3	Petroleum Refinery Piping
B36.19	Stainless Steel Pipe
B40.1	Gages, Pressure and Vacuum Indicating Dial Type-Elastic Element

(Application for copies should be directed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

American Society for Testing and Materials

A182	Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings and Valves and Parts for High-Temperature Service
A312	Specifications for Seamless and Welded Austenitic Stainless Steel Pipe
A403	Specifications for Wrought Austenitic Stainless Steel Piping Fittings

(Application for copies should be directed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103)

Manufacturers Standardization Society of the Valve and Fitting Industry

MSS-SP-6	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
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MSS-SP-61

Hydrostatic Testing of Steel Valves

(Application for copies should be directed to the Manufacturers' Standardization Society of Valve and Fittings Industry, 1815 N. Fort Myer Drive, Arlington, VA 22209.)

American Society of Mechanical Engineers

Boiler and Pressure Vessel Code Section VIII, Pressure Vessels, Divisions 1 and 2

(Application for copies should be directed to the American Society of Mechanical Engineers, 345 East 47th Street, New York 17, NY)

National Fire Protection Association

NFPA-70

National Electric Code

NFPA-30

Flammable and Combustible Liquids Code

National Fire Codes, Flammable Liquids and Gases, Flammable Liquids Codes

(Application for copies should be directed to the National Fire Protection Association, 60 Batterymarch Street, Boston, MA 02110)

3. REQUIREMENTS

3.1 General. - Hydrocarbon fuel ground support equipment shall be designed in compliance with the requirements of this standard.

3.1.1 Useful Life. - Hydrocarbon fuel ground support equipment useful life requirements shall be in compliance with GP-863.

3.1.2 Reliability. - Hydrocarbon fuel ground support equipment reliability requirements shall be in compliance with GP-863.

3.1.3 Maintainability. - Hydrocarbon fuel ground support equipment maintainability requirements shall be in compliance with GP-863.

3.1.4 Human Engineering. - Hydrocarbon fuel ground support equipment human engineering requirements shall be in compliance with GP-863.

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3.1.5 Special Capabilities. - For failure modes which could result in a time-critical emergency (see 6.2), provision shall be made for automatic switching to a safe mode of operation. Caution and warning shall be provided for these time-critical functions.

3.1.6 Safety. - Equipment shall be designed to preclude failures or hazards that would jeopardize personnel safety or damage or degrade the flight vehicle, in compliance with GP-863.

3.1.6.1 Safety Factors. - The design factor of safety shall be four to one (4 to 1) based on ultimate strength of the material.

3.1.6.1.1 Proof Pressure. - Proof pressure shall be 150 percent of maximum allowable working pressure (see 6.2).

3.1.6.1.2 Burst Pressure. - Burst pressure shall be at least 400 percent of maximum allowable working pressure (see 6.2).

3.1.6.2 Intermixing. - Provisions to prevent intermixing of hydrocarbon fuels shall be included in all designs.

3.1.6.2.1 Segregation of Products. - Separate receiving, storing, and dispensing facilities shall be provided for each type and grade of hydrocarbon fuel.

3.1.6.3 Vapor Disposal. - Provisions shall be included for the safe disposal of hydrocarbon fuel vapors in accordance with NFPA-30.

3.1.6.4 Quantity Distance. - Safety requirements for quantity distance limitations for the handling and storage of hydrocarbons as specified in GP-469 shall be complied with.

3.1.6.5 Hazard Proofing. - Purging of electrically energized equipment for hazard proofing shall be in compliance with KSC-STD-E-0002 and DTI-M-23.

3.1.6.6 Fire Protection. - Fire protection design for hydrocarbon fuel systems GSE shall be in compliance with KSC-STD-F-0004.

3.1.6.7 Lightning Protection. - Lightning protection design for hydrocarbon fuel systems GSE shall be in compliance with KSC-STD-E-0013.

3.1.7 Environmental Protection. - Equipment shall be capable of withstanding, without damage or degradation of performance, continuous exposure to the natural and induced environmental conditions as

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occurring at Kennedy Space Center, Florida, in compliance with the requirements of GP-863.

3.1.7.1 Corrosion Protection. - Metals shall be painted to conform to KSC-STD-F-0001, TM-584, and DTI-M-14, as applicable, for corrosion protection.

3.1.7.2 Cathodic Protection. - Cathodic protection shall be provided to minimize electrolytic corrosion of underground equipment and shall be designed such that a periodic check of current flow can be obtained.

3.1.7.3 Purging. - Purging for environmental protection shall conform to the requirements of DTI-M-23.

3.1.8 Special Tools. - The design of equipment and components shall minimize the requirements for special tools.

3.1.9 Color Coding. - Pipe and tubing shall be color coded in compliance with KSC-STD-S-0004.

3.1.10 Cleaning. - All internal surfaces of pipe, tubing, fittings, components, etc., shall be cleaned to Level IV of KSC-C-123.

3.1.11 Bonding and Grounding. - Bonding and grounding shall be in compliance with KSC-STD-E-0012.

3.1.12 Welding. - Welding of stainless steel pipe, tubing, fittings, etc., shall conform to the following:

KSC-SPEC-Z-0003	Stainless Steel and Invar 36 Pipe, Stainless Steel Tubing and Fittings
KSC-SPEC-Z-0004	Structural, Carbon Steel, Stainless Steel, Low Alloy Steel and Aluminum Alloys
KSC-SPEC-Z-0002	Aluminum Alloy Pipe, Tubing and Associated Fittings
KSC-SPEC-Z-0010	T-1 and T-1 Type A and Type B Structural Steels
KSC-SPEC-Z-0016	Automatic Welding, Stainless Steel Pipe and Tubing, Invar 36 Pipe, Carbon Steel Pipe, Aluminum Pipe

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3.1.12.1 Nondestructive Testing. - Major hydrocarbon fuel launch systems piping weldments shall be 100 percent radiographically inspected in compliance with the applicable welding specification.

3.1.12.2 Other Inspection. - The methods of other nondestructive inspections shall be as specified in KSC-SPEC-Z-0013.

3.1.13 Ecological Considerations. - Consideration shall be given to ecological or environmental impact caused by installation, operation, maintenance, or malfunctions of proposed, new, or altered systems in compliance with GP-863.

3.1.14 Marking of Ground Support Equipment. - Marking of hydrocarbon fuel system GSE shall be in compliance with KSC-STD-E-0015.

3.1.15 Component Selection. - Component selection shall be in accordance with the requirements of GP-863.

3.1.15.1 Materials. - All components and equipment shall be constructed of materials that are suitable for the intended use. All materials that could come into contact with the service media shall be compatible with hydrocarbon fuel.

3.1.15.2 Component Identification. - All components and equipment shall be permanently and legibly marked for identification in accordance with the requirements of GP-863.

3.1.16 Dissimilar Metals. - The use of dissimilar metals shall be in accordance with the requirements of TM-584.

3.2 Fixed Installations. - Fixed installations for hydrocarbon fuel GSE shall provide such functions as receiving, storing, conditioning, and dispensing of one or more types of fuel. Separate systems shall be provided for each type and/or grade, to positively assure against intermixing one type or grade with another.

3.2.1 Installation. - Installation requirements for fixed installations shall comply with the following requirements.

3.2.1.1 Electric Power. - Electrical power systems installation shall comply with the National Electrical Code (NEC).

3.2.1.2 Pneumatics. - Pneumatic system installations shall comply with KSC-STD-Z-0005.

3.2.1.3 Siting. - Siting for fixed installations shall be in compliance with the requirements of GP-469.

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3.2.1.4 Layout. - The general layout shall provide adequate spacing between tanks, unloading areas, waste disposal facility, etc. Clearance requirements shall be in accordance with the provisions of NFPA Standard No. 30, Flammable and Combustible Liquids Code.

3.2.1.5 Buildings. - Building construction shall comply with NFPA Standard No. 30, Flammable and Combustible Liquids Code.

3.2.1.6 Safety. - All installations shall have safety systems such as water spray, foaming, personnel showers and eye-wash, fire hydrants, fire extinguishers. Requirements for contamination level warning shall be in compliance with GP-863.

3.2.1.7 Security. - Controlled access, perimeter fencing, hazardous warning lights and signs shall be incorporated at all fixed installations.

3.2.2 Storage Area. - Hydrocarbon fuel system storage area design shall comply with the following requirements.

3.2.2.1 Tanks. - All tanks shall be installed above ground with adequate diking to retain fuel spillage and shall be earth-covered to provide tank insulation and blast protection.

3.2.2.2 Pump House. - Pump houses shall shelter all control equipment such as pumps, filter-separators, valves, etc.

3.2.2.3 Maintenance Building. - A separate maintenance building shall be provided and shall incorporate provisions for equipment repair, test, refurbishment, etc.

3.2.3 Waste Disposal. - Hydrocarbon fuel waste disposal systems shall conform to the requirements of GP-863 for the safe disposal of hydrocarbon waste products.

3.2.3.1 Tanks. - All tanks shall be installed above ground with adequate diking to retain fuel spillage and shall be earth-covered to provide tank insulation and blast protection.

3.2.3.2 Fuel Separators. - Fuel separator sumps of approved design shall be provided to contain spills that could enter sewage systems.

3.3 Mobile Equipment. - For the purposes of this standard, mobile equipment shall be divided into two types: (1) mobile equipment for highway usage and (2) mobile equipment for non-highway usage. Electrical requirements for all mobile equipment shall be in

compliance with KSC-E-165.

3.3.1 Mobile Equipment for Highway Use. - Highway usage mobile equipment shall be designed to meet Interstate Commerce Commission (ICC) regulations.

3.3.2 Mobile Equipment for Non-Highway Use. - Non-highway usage mobile equipment shall be designed to meet the specific requirements involved.

3.4 Portable Equipment. - All portable equipment shall be designed to meet the specific requirements involved. Electrical requirements for all portable equipment shall be in compliance with KSC-E-165.

3.5 COMPONENTS

3.5.1 Flexible Hoses. - Flexible hose assemblies shall be corrugated metal tube type inner liner, with wire braid outer cover and either tube type (to mate with a KC105 fitting end) or flanged (lapped joint in conformance with ANSI B16.5) end connections.

3.5.1.1 Materials.

3.5.1.1.1 Inner Liner. - The inner liner shall be type 304 or 316 stainless steel.

3.5.1.1.2 Outer Cover. - The outer cover shall be type 304L or 316L stainless steel.

3.5.1.1.3 End Connections. - Tube type end connections shall be type 316 stainless steel. Flanges (for lapped joints) shall be in compliance with ASTM A182 Grade F304. The stub-end shall be in compliance with ASTM A403, Grade WP304 and shall be concentric serrated in conformance with MSS-SP-6.

3.5.2 Valves. - Hydrocarbon fuel system valve design shall conform to the following requirements.

3.5.2.1 Shutoff. - Shutoff valves shall be either globe type, angle type, gate type, or ball type.

3.5.2.2 Metering. - Metering valves shall be needle type.

3.5.2.3 Check. - Check valves shall be spring loaded type, with soft seat.

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3.5.2.4 Relief. - Relief valves shall be direct operating, with soft seat.

3.5.2.5 Flow Control. - Flow control valves shall be pilot operated, pneumatic powered type.

3.5.2.6 End Connections. - Valve end connections shall conform to the following requirements.

3.5.2.6.1 Flanges. - Flanges shall conform to ANSI B16.5.

3.5.2.6.1.1 Materials. - Flange material shall be in compliance with ASTM A182, Grade F304.

3.5.2.6.1.2 Face Design. - All flanges shall be raised face and shall be concentric serrated in conformance with MSS- SP-6

3.5.2.6.2 Tube Type. - Tube type end connections shall conform to the following:

Male
Female (Bosses)

KC105 of KSC GP-425
MC240 or ANDI0050/MS33649

3.5.2.6.2.1 Materials. - Tube fitting materials shall be type 316 stainless steel in accordance with KSC-F-124.

3.5.2.7 Allowable Leakage.

3.5.2.7.1 Internal Leakage. - Internal leakage for valves (not leakage to atmosphere) shall be in compliance with MSS SP-61.

3.5.2.7.2 External Leakage. - External leakage for all valves shall be zero throughout all of the design and proof operating ranges.

3.5.3 Filters. - Filters shall be woven wire type and shall have provision to drain fuel from the unit when the adjacent piping is drained; and shall also incorporate pressure differential connections. End connections shall be flanged type.

3.5.3.1 Materials. -

3.5.3.1.1 Filter Element. - The filter element shall be 300 series stainless steel.

3.5.2.1.2 Filter Housing. - The filter housing shall be type 304 or 316 stainless steel.

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3.5.3.1.3 Flanged End Connections. - Flange material shall be in compliance with ASTM A182, Grade F304.

3.5.3.2 Allowable Leakage. - The filter assembly shall provide zero leakage (to atmosphere) throughout all of the design and proof pressure ranges.

3.5.4 Strainers. - All strainers shall be full line size basket type. The strainer shall have a top cover, a manual bleed port in the top cover, a bottom drain plug, removable baskets and flanged end connections conforming to ANSI B16.5.

3.5.4.1 Materials.

3.5.4.1.1 Strainer. - The strainer housing shall be type 304 or 316 stainless steel.

3.5.4.1.2 Strainer Baskets. - The removable strainer baskets shall be type 316 stainless steel woven wire reinforced with a monel or stainless steel screen.

3.5.5 Filter Separators. - Filter separator assemblies shall conform to the requirements of MIL-F-8901.

3.5.5.1 Construction. - The filter separator assembly shall consist of a tank or body, automatic flow controlling discharge valve, filtering and water removal elements, an automatic air venting valve, a float control mechanism for water discharge, a pressure relief valve, a fuel sight gage, a differential pressure indicating gage, and any other accessories required to perform manual drawing, venting, component maintenance and component operations. The filter separator shall incorporate filtering and water removal elements that may be replaced without disconnecting any of the attached piping. Means for handling the main closure without separate hoisting equipment shall be provided. The filter separator unit, with automatic valve, shall be complete with interconnecting piping and tubing. The pipeline connections shall be flanged connections; tube fittings shall comply with KSC-GP-425.

3.5.5.1.1 Body. - The design and manufacture of the filter separator body shall be in conformance with the ASME Specification Boiler and Pressure Vessel Code, Section VIII - Unfired Pressure Vessels, and shall be inspected and labeled as such.

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3.5.5.2.1 Metals. - All metallic components of the filter separator (except the water separator elements) shall be type 316 stainless steel.

3.5.5.2.1.1 Water Separator Elements. - The water separator elements shall be teflon coated metal type.

3.5.5.2.2 Non-Metals. - All gaskets, o-rings and seals shall be Buna-N Shore A-60 hardness nominal.

3.5.6 Pumps. - All pumps shall be centrifugal type and shall be specifically designed for pumping hydrocarbon jet aircraft fuels.

3.5.6.1 Construction.

3.5.6.1.1 Pump Impeller. - The pump impeller shall be both statically and dynamically balanced.

3.5.6.1.2 Pump Case. - The pump case shall be constructed so that the pump may be dismantled for inspection or repair without disturbing the suction or discharge connections or the motor mounting.

3.5.6.1.3 Seals. - The pump shall be provided with a balanced internal mechanical seal fitted to the pump shaft. The seal shall be properly sized and fitted and shall not require a break-in operation to seal effectively.

3.5.6.1.4 Gage Connections. - The suction and discharge sides of the pump shall have gage connections, each fitted with a 300 series stainless steel plug conforming to MS33656.

3.5.6.2 Pump Motor. - The drive motor (pump motor) shall be continuous duty, explosion proof and in compliance with NEMA and NEC standards for the application involved.

3.5.6.3 Non-Metals. - All seals, gaskets, packings, o-ring, etc., contained on or in the pump assembly shall be suitable for the intended purpose and shall be compatible with the service media.

3.5.6.4 Metals. - All metals shall be suitable for the intended purpose and shall be compatible with the service media.

3.5.7 Tanks. - All tanks shall be constructed in compliance with ASME Specification, Boiler and Pressure Vessel Code, Section VIII, (Unfired) Pressure Vessels, Subsection B, Part UW.

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3.5.7.1 Installation. - All tanks shall be installed above ground with adequate diking to retain fuel spillage and shall be earth-covered to provide tank insulation and blast protection.

3.5.7.1.1 Appurtenances. - Storage tanks shall be fitted with the necessary flanged openings properly sized and located to receive the safety and operational devices required.

3.5.7.2 Materials.

3.5.8.2.1 Tanks. - The tank shall be either type 316 stainless steel conforming to ASTM A240 or of clad plate composed of a carbon steel backing plate to which is permanently bonded a single thickness of corrosion-resistant type 316 stainless steel sheeting.

3.5.7.2.2 Associated Hardware.

3.5.7.2.2.1 Metals. - All metals shall be type 304 or 316 stainless steel.

3.5.7.2.2.2 Non-Metals. - All non-metals (e.g. - gaskets, seals, etc.) shall be suitable for the intended use and shall be compatible with the service media.

3.5.7.2.3 Coating Material. - Tank external surfaces and associated structural support shall be coated in accordance with KSC-STD-F-0001 or DTI-M-14 or TM-584.

3.5.8 Surge Suppressors. - Surge suppressors (shock arrestors) shall be metal bellows type designed for GN₂ precharge, and shall have a precharge pressure gage, GN₂ charging valve and a flanged pipe connection.

3.5.8.1 Materials.

3.5.8.1.1 Outer Shell. - The outer shell shall be welded steel.

3.5.8.1.2 Diaphragm Bellows. - The diaphragm bellows shall be type 316 stainless steel.

3.5.9 Jet-Eductors. - Jet-Eductors shall be venturi type and shall have a removable nozzle; end connections shall be flanged type.

3.5.10 Expansion Joints. - Expansion joints shall be sleeve type, with flanged ends.

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3.5.11 Quick-Disconnect Coupling. - Quick-disconnect couplings shall be cam locking type with a female coupler, a male nipple, a dust plug, and a dust cap.

3.5.12 Instrumentation.

3.5.12.1 Liquid Sensors. - Liquid sensors shall be magnetostrictive oscillator type. The liquid sensor assembly shall be capable of indicating the presence or absence of hydrocarbon fuels.

3.5.12.2 Temperature Sensor. - Temperature sensors shall be of the transducer type.

3.5.12.3 Liquid Level Gage. - Suitable remote reading liquid level indicators or gauges calibrated for indicating the contents of the tanks shall be provided.

3.5.12.4 Pressure Gages. - Pressure gages shall be one piece, solid front construction utilizing a shatterproof, tempered glass window and full diameter safety release back cover. All gages shall be designed for flush, front panel mounting. Additional requirements shall be as specified in ANSI B40.1.

3.5.12.4.1 Selection. - Pressure gages shall be selected so that the normal indicator position falls in the middle third of the pressure range. Pressure gages shall also be selected such that the maximum pressure which can be applied will not exceed the range of the gage.

3.5.12.4.2 Pressure Connections. - Pressure connections on gages shall be designed to mate with either 1/4", 3/8", or 1/2" tube fitting sizes.

3.5.12.5 Flow Meters. - Flow meters shall be bi-directional, volumetric measuring types. The flow meter shall be selected such that all system flow rates are well within the operating range of the flow meter.

3.6 Pipe and Fittings.

3.6.1 General. - Pipe and fittings shall conform to the following requirements.

3.6.1.1 Welding. - All welding of stainless steel pipe and associated fittings shall be in compliance with KSC-SPEC-Z-0003.

3.6.1.2 Supports and Anchors. - Pipe, pipe accessories, support anchors and braces, etc., shall be installed in compliance with ANSI B31.3.

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3.6.1.3 Pickling and Passivation. - Stainless steel pipe and fittings shall be pickled free of scale and fully passivated.

3.6.1.4 Protective Coatings. - Stainless steel pipe and fittings, anchors and braces, etc., shall be painted in such a manner to meet the same requirements defined in DTI-M-14 for stainless steel tubing and fittings.

3.6.2 Pipe. - Pipe shall conform to ANSI B36.19.

3.6.2.1 Material. - Pipe material shall conform to ASTM A312, Grade TP304L.

3.6.3 Pipe Fittings. - Pipe fittings shall conform to ANSI B16.9.

3.6.3.1 Material. - Pipe fittings material shall conform to ASTM A403, Grade WP304L.

3.6.4 Flanged Connections.

3.6.4.1 Flanges. - Flanges shall conform to ANSI B16.5, and shall be restricted to the following types:

Slip On
Weld Neck
Lap Joint
Blind

3.6.4.1.1 Materials. - Flange material shall conform to ASTM A182, Grade F304L.

3.6.4.1.2 Face Design. - All flanges shall be raised face and shall be concentric serrated in conformance with MSS-SP-6.

3.6.4.2 Gaskets. - Gaskets conforming to ANSI B16.21 shall be installed between flanges at all flanged connections.

3.6.4.2.1 Material. - Gasket material shall be asbestos fiber bounded in Buna-N, 1/16 inch thick, and shore A-60 hardness nominal.

3.6.4.3 Studs. - Stud threads shall conform to ANSI B1.1. Stud material shall be 304 or 316 stainless steel.

3.6.4.4 Bolts. - Bolts shall conform to ANSI B18.2. Bolt material shall be 304 or 316 stainless steel.

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3.6.4.4 Nuts. - Nuts shall conform to ANSI B18.2. Nut material shall be 304 or 316 stainless steel.

3.6.4.6 Washers. - Washers shall be used on all bolts and studs at flanged connections. Washer material shall be 304 or 316 stainless steel.

3.6.5 Grooved Coupling Connections.

3.6.5.1 Grooved-End Pipe. - Pipe grooves shall conform to MIL-P-10388.

3.6.5.2 Pipe Coupling Clamp. - Pipe coupling clamps shall conform to MIL-C-10387. The material shall be 304 stainless steel.

3.6.5.3 Gasket. - Gaskets for grooved coupling connections shall conform to MIL-C-10387. The gasket material shall also comply with MIL-C-10387.

3.6.6 Threaded Connections.

3.6.6.1 Tapered Threads. - Pipe (e.g. - tapered) threads shall not be used.

3.6.6.2 Straight Threads. - The use of straight threads shall be restricted to those connections which require conversion from pipe to tubing. The threaded connection on the pipe or fitting shall be a threaded boss (female port) conforming to MS33649.

3.7 Tubing and Fittings.

3.7.1 General. - Tubing and fittings shall conform to the following requirements.

3.7.1.1 Welding. - All welding of stainless steel tubing and tubing assemblies shall be Gas Tungsten-Arc Welding (GTAW) in compliance with KSC-SPEC-Z-0003.

3.7.1.2 Fabrication and Installation. - Fabrication and installation of fittings and fitting assemblies shall be in compliance with KSC-SPEC-Z-0008.

3.7.1.3 Protective Coatings. - All stainless steel tubing, fittings, supports, etc., shall be painted in accordance with DTI-M-14.

3.7.2 Tubing. - Tubing shall conform to KSC-SPEC-Z-0007.

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3.7.2.1 Material. - Tubing material shall be type 304 stainless steel in accordance with KSC-SPEC-Z-0007.

3.7.3 Tube Fittings. - Tube fittings shall conform to KSC-F-124 and KSC-GP-425.

3.7.3.1 Material. - Tube fittings material shall be type 316 stainless steel in accordance with KSC-F-124

3.7.4 Gaskets. - All gaskets for tubing and fitting connections shall conform to the following requirements.

3.7.4.1 Flared Tube Connections. - Seal ring gaskets for flared tube connections shall conform to KC-103 of KSC-GP-425. The material shall comply with MIL-R-8791.

3.7.4.2 Boss Connections. - O'ring gaskets for boss connections shall conform to MS28778. The material shall comply with MIL-R-8791.

3.8 Metal Plates and Shapes.

3.8.1 General. - Metal plates and shapes shall conform to the following requirements.

3.8.1.1 Welding. - Welding of metal plates and shapes shall comply with KSC-SPEC-Z-0004.

3.8.1.2 Protective Coatings.

3.8.1.2.1 Carbon Steel. - Painting of carbon steel metal plates and shapes shall comply with KSC-STD-F-0001 and TM-584.

3.8.1.2.2 Stainless Steel. - Painting of stainless steel metal plates and shapes shall comply with TM-584.

3.8.1.2.3 Aluminum. - Painting of aluminum metal plates and shapes shall comply with TM-584.

3.8.2 Materials.

3.8.2.1 Carbon Steel. - Carbon steel plates, sheets, bars, rods, and shapes, etc., shall comply with QQ-S-741.

3.8.2.2 Stainless Steel. - Stainless steel plates, sheets, bars, rods and shapes, etc., shall be type 304L stainless steel in compliance with QQ-S-763 and QQ-S-766 as applicable.

3.8.2.3 Aluminum. - Aluminum plates, sheets, bars, rods, and shapes etc., shall be tempered aluminum alloy 6061-T6 in compliance with QQ-A-200/8 and QQ-A-250/11 as applicable.

3.9 Design Documentation.

3.9.1 Specifications. - Detailed design specifications shall be prepared in accordance with the requirements of GP-863.

3.9.2 Drawings. - Detailed design drawings shall be prepared in accordance with the requirements of GP-863.

3.9.3 Manuals. - Technical manuals shall be prepared in accordance with the requirements of GP-863.

4. QUALITY ASSURANCE PROVISIONS

4.1 Design and Development Controls. - The designer shall ensure that the following are specified as required to assure quality and to fulfill the design intent:

a. Inspection and test criteria (including specific NDT methods, test equipment, environmental conditions and sample size).

b. Identification and data retrieval requirements.

c. Identification of critical hardware characteristics necessary for procurement and fabrication.

d. Performance and/or tolerance limits.

e. Applicable specifications for cleanliness/contamination control.

f. Applicable process specifications, standards, and procedures.

g. Limited life requirements.

h. Acceptance/rejection criteria.

i. Handling, storage, preservation, marking, labeling, packaging, packing and shipping requirements.

j. Equipment to be placed under integrity control.

4.2 Contractural Requirements. - When this standard is invoked in a contract, the statement of work shall invoke the applicable provisions of NHB 5300.4(1C), "Inspection System Provisions for Aeronautical and Space System Materials, Parts, Components, and

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Services" and/or NHB 5300.4(1B), "Quality Program Provisions for Aeronautical and Space System Contractors".

5. PREPARATION FOR DELIVERY

5.1 Cleanliness. - Internal cleanliness of fluids systems shall meet or exceed KSC-C-123, Level IV.

5.2 Pressurization. - Fluids systems shall be pressurized to 5 ± 1 psig With GN₂ to prevent intrusion of contamination.

5.3 Packing and Marking for Shipments. - Items to be shipped shall be securely packaged and packed in appropriate shipping containers which will provide adequate protection against damage or degradation of any kind during shipment. All applicable carrier rules shall be complied with. Containers shall be marked to conform to MIL-STD-129.

6. NOTES

6.1 Intended Use. - This standard is intended for use in the design and construction of all hydrocarbon fuels ground support equipment, for use at KSC, involving any of the propellants listed in 1.1.

6.2 Terms and Definitions. - The following definitions apply to the corresponding terms as used in this document.

6.2.1 Fixed equipment. - Designed to remain in place, attached to permanent foundations.

6.2.2 Mobile equipment. - Designed to be moved from place to place, usually on wheels, skids, etc.

6.2.3 Portable equipment. - Designed to be carried by the individual, usually the user.

6.2.4 Critical Function. - A critical function is defined as a function which if lost would cause loss of personnel or the flight vehicle.

6.2.5 Proof Pressure. - The pressure to which system components and associated hardware are subjected to fulfill the acceptance requirements of the customer, in order to give evidence of satisfactory workmanship and material quality, and to establish the maximum undetected flaw size in the components and associated hardware. Proof pressure is the product of maximum allowable

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working pressure times the proof factors. Burst pressure is the product of maximum allowable working pressure times the burst factors

6.2.6 Burst Pressure. - (See 6.2.5)

6.2.7 Hydrocarbon Fuels. - The following defines the applicable specifications.

JP-4, JP-5

MIL-T-5624

ASTM Type A, Type B

American Society of Testing Materials,
Part 17

RP-1

MIL-P-25576

RJ-1

MIL-F-25558

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